Claims

[c1] 1. An apparatus for *in situ* monitoring of molten polymer and/or oligomer composition comprising:

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a light source;

a fiber optic transmission probe, wherein said probe transmits at least one substantially monochromatic radiation from said light source to irradiate a sample comprising at least one polymer and/or oligomer and collects light transmitted from said irradiated sample;

a spectrophotometer, wherein said spectrophotometer monitors radiation comprising UV/visible light absorbed by said irradiated sample; and

a data analysis system, wherein said data analysis system correlates absorbance to at least one predetermined reaction component.

[c2] 2. The apparatus of claim 1, wherein said probe is maintained at a substantially constant temperature.

[c3] 3. The apparatus of claim 1, wherein said probe comprises a high temperature probe.

[c4] 4. The apparatus of claim 3, wherein said probe is immersed in the polymer sample.

[c5] 5. The apparatus of claim 3, wherein said probe operates at a temperature in the range from 200 ^{o}C to 400 ^{o}C.

[c6] 6. The apparatus of claim 3, wherein said probe operates at a temperature in the range from 250 ^{o}C to 350 ^{o}C.

[c7] 7. The apparatus of claim 3, wherein said probe operates at a temperature in the range from 260 ^{o}C to 330 ^{o}C.

[c8] 8. The apparatus of claim 1, further comprising a filter positioned between said light source and said spectrophotometer.

[c9] 9. The apparatus of claim 1, wherein said data analysis system comprises univariate analysis.

[c10] 10. The apparatus of claim 1, wherein said data analysis system comprises multivariate analysis.

[c11] 11. The apparatus of claim 1, wherein said sample comprising at least one polymer and/or oligomer comprises molten polycarbonate.

[c12] 12. The apparatus of claim 11, wherein said polycarbonate comprises melt polycarbonate.

[c13] 13. The apparatus of claim 12, wherein said melt polycarbonate is produced by polymerization of bisphenol A (BPA) and diphenyl carbonate (DPC).

[c14] 14. The apparatus of claim 1, wherein said reaction component comprises uncapped phenolic end-groups.

[c15] 15. The apparatus of claim 1, wherein said reaction component comprises Fries products.

[c16] 16. The apparatus of claim 15, wherein said Fries rearrangement products consist of linear Fries products.

[c17] 17. The apparatus of claim 15, wherein said Fries rearrangement products consist of branched Fries products.

[c18] 18. The apparatus of claim 15, wherein said monitored absorbance comprises at least one substantially monochromatic wavelength in the range of 250 to 450 nm.

[c19] 19. The apparatus of claim 15, wherein said monitored absorbance comprises at least one substantially monochromatic wavelength in the range of 280 to 400 nm.

[c20] 20. The apparatus of claim 15, wherein said monitored absorbance comprises at least one substantially monochromatic wavelength in the range of 290 to 330 nm.

[c21] 21. The apparatus of claim 15, wherein said monitored absorbance comprises a wavelength of about 320 nm.

[c22] 22. The apparatus of claim 1, wherein said monitored absorbance is correlated to predetermined reaction components comprising Fries products and uncapped phenolic end-groups.

[c23] 23. The apparatus of claim 22, wherein said monitored absorbance comprises at least two substantially monochromatic wavelengths in the range of 250 to 450 nm.

[c24] 24. The apparatus of claim 22, wherein said monitored absorbance comprises at least two substantially monochromatic wavelengths in the range of 260 to 400 nm.

[c25] 25. The apparatus of claim 22, wherein said monitored absorbance comprises at least two substantially monochromatic wavelengths in the range of 270 to 340 nm.

[c26] 26. Computer readable media comprising software/code for the apparatus of claim 1.

[c27] 27. A method for *in situ* monitoring of molten polymer and/or oligomer composition comprising:

providing an optical contact between a fiber optic probe and a stream of a molten sample comprising at least one polymer and/or oligomer;

irradiating the molten sample with at least one wavelength of substantially monochromatic radiation;

monitoring UV/visible light adsorbed by the molten sample; and

correlating the UV/visible light absorbed by the irradiated molten sample to levels of at least one reaction component of interest.

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[c28] 28. The method of claim 27, wherein the probe is maintained at a substantially constant temperature.

[c29] 29. The method of claim 27, further comprising using a high temperature probe for irradiating the polymer and collecting light transmitted from the polymer.

[c30] 30. The method of claim 29, wherein the probe is immersed directly in the polymer sample.

[c31] 31. The method of claim 29, wherein said probe operates at a temperature in the range from 200 ^{o} C to 400 ^{o} C.

[c32] 32. The method of claim 29, wherein said probe operates at a temperature in the range from 250 ^{o} C to 350 ^{o} C.

[c33] 33. The method of claim 29, wherein said probe operates at a temperature in the range from 260 ^{o} C to 330 ^{o} C.

[c34] 34. The method of claim 27, wherein the sample comprises melt polycarbonate.

[c35] 35. The method of claim 34, wherein the melt polycarbonate is produced by polymerization of bisphenol A (BPA) and diphenyl carbonate (DPC).

[c36] 36. The method of claim 27, wherein the step of correlating the UV/visible light absorbed by the irradiated molten sample to levels of a reaction component of interest further comprises univariate analysis.

[c37] 37. The method of claim 27, wherein the step of correlating the UV/visible light absorbed by the irradiated molten sample to levels of a reaction component of interest further comprises multivariate analysis.

[c38] 38. The method of claim 27, wherein the reaction component comprises uncapped phenolic end-groups.

[c39] 39. The method of claim 27, wherein the reaction component comprises Fries.

[c40] 40. The method of claim 39, wherein the reaction component consists of linear Fries.

[c41] 41. The method of claim 39, wherein the reaction component consists of branched Fries.

[c42] 42. The method of claim 39, wherein the monitored absorbance comprises at least one substantially monochromatic wavelength in the range of 250 to 450 nm.

[c43] 43. The method of claim 39, wherein the monitored absorbance comprises at least one substantially monochromatic wavelength in the range of 280 to 400

nm.

[c44] 44. The method of claim 39, wherein the monitored absorbance comprises at least one substantially monochromatic wavelength in the range of 290 to 330 nm.

[c45] 45. The method of claim 39, wherein the monitored absorbance comprises a wavelength of about 320 nm.

[c46] 46. The method of claim 27, wherein the monitored absorbance is correlated to reaction components comprising Fries products and uncapped phenolic end-groups.

[c47] 47. The method of claim 46, wherein the monitored absorbance comprises at least two substantially monochromatic wavelengths in the range of 250 to 450 nm.

[c48] 48. The method of claim 46, wherein the monitored absorbance comprises at least two substantially monochromatic wavelengths in the range of 260 to 400 nm.

[c49] 49. The method of claim 46, wherein the monitored absorbance comprises at least two substantially monochromatic wavelengths in the range of 270 to 340 nm.

[c50] 50. The method of claim 27, wherein the reaction component of interest is measured during production of the polymer.

[c51] 51. The method of claim 27, wherein irradiation and monitoring of light absorbed is performed on combinatorial libraries of samples.

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[c52] 52. The method of claim 27, further comprising applying a predetermined selection test to determine whether any one of a set of preselected reaction components needs to be adjusted.

[c53] 53. Computer readable media comprising software code for performing the method of claim 24.

[c54] 54. A method for real time monitoring of molten polycarbonate composition during production comprising:

positioning an optical probe in optical contact with a stream of molten sample comprising at least one polymer and/or oligomer such that the probe maintains a substantially constant temperature;
irradiating the molten sample with at least one wavelength of substantially monochromatic radiation;
monitoring UV/visible light absorbed by the irradiated sample; and
correlating the light absorbed by the irradiated sample to levels of Fries products.

[c55] 55. A method for real time monitoring of molten polycarbonate composition during production comprising:

positioning an optical probe in optical contact with a stream of molten sample comprising at least one polymer and/or oligomer, such that the probe comprises a substantially constant temperature;
irradiating the molten sample with at least two wavelengths of substantially monochromatic radiation;
monitoring UV/visible light absorbed by the irradiated sample; and
correlating the light absorbed by the irradiated sample to levels of Fries products and phenolic end-groups.

[c56] 56. A method for real time monitoring of molten polycarbonate composition during production comprising:

positioning an optical probe in optical contact with a stream of molten sample comprising at least one polymer and/or oligomer, such that the probe comprises a substantially constant temperature;
irradiating the molten sample with at least three wavelengths of substantially monochromatic radiation;
monitoring UV/visible light absorbed by the irradiated sample; and
correlating the light absorbed by the irradiated sample to levels of linear Fries products, branched Fries products, and phenolic end-groups.